

# ***B/CS Unified Design Guideline Manual***

***Water and Sewer  
Effective February, 2004***



# **BRYAN / COLLEGE STATION**

# **UNIFORM DESIGN GUIDELINES**

**Glossary**

# GLOSSARY

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<b>ADA</b>	American Disabilities Act
<b>Alley</b>	A minor public right-of-way which provides a secondary means of vehicular access to abutting property and which is used primarily for vehicular traffic to the rear or side of properties which otherwise abut on a public street.
<b>City</b>	The municipality of the City of Bryan and/or the municipality of the City of College Station.
<b>City Engineer</b>	The chief administrative employee of Engineering Services, or his/her duly authorized representative(s).
<b>City Manager</b>	The chief administrative employee of the City Council, or his/her duly authorized representative(s).
<b>Collection Line</b>	A wastewater line which receives only the flow from abutting property.
<b>Collection Main</b>	A wastewater line which receives the flow from abutting property and from one or more collection lines or mains.
<b>Collector Street</b>	A street which primarily serves vehicular traffic from local streets and minor collectors to arterials. A collector may also provide very limited access to abutting properties if approved by the City.
<b>Conduit</b>	Any closed device for conveying flowing water.
<b>Critical Feature</b>	An integral and readily identifiable part of an infrastructure system, without which the effect(s) provided by the entire system would be compromised.
<b>Design Engineer</b>	See Licensed Professional Engineer.
<b>Developer/Builder</b>	A person, partnership, or corporation engaged in the development of land and/or building of structures and not excluded by exemption sections of this manual.

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<b>Development</b>	Any man-made change to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation, drilling operations, grading, or clearing.
<b>Environmental Protection Agency (EPA)</b>	The United States Environmental Protection Agency, the regional office thereof, any federal department, agency, or commission that may succeed to the authority of the EPA, any duly authorized official of EPA or such successor agency.
<b>Extra-Territorial Jurisdiction (E.T.J.)</b>	The unincorporated area, not a part of any other city, which is contiguous to the corporate limits of the City of Bryan and/or the City of College Station, the outer boundaries of which are measured from the extremities of the corporate limits of the city, outward for such distances as may be stipulated in the Texas Municipal Annexation Act, in which area, within the terms of the act, the City may enjoin the violation of it's subdivision control chapter.
<b>Hydraulic Gradient</b>	A line representing the pressure head available at any given point within the drainage system.
<b>Interceptor</b>	A wastewater line which receives flow from collection lines and/or mains but not from any abutting property.
<b>Licensed Professional Engineer (PE)</b>	A person who has been duly licensed by the Texas Board of Professional Engineers to engage in the practice of engineering in the State of Texas.
<b>Local Jurisdiction</b>	The local governing body in which the construction takes place (known also as 'the City').
<b>Local Street</b>	A street which primarily serves vehicular traffic to abutting residential properties. A local may also provide limited access to commercial properties if approved by the City.
<b>Major Arterial Street</b>	A street which carries high volumes of vehicular traffic (in the general range of 20,000 VP to 60,000 VP) and which is intended to move traffic in, out or around the City.

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<b>Minor Arterial Street</b>	A street which carries high volumes of vehicular traffic (in the general range of 5,000 VP to 30,000 VP) and which is intended to move traffic around the City.
<b>Minor Collector Street</b>	A street which primarily serves vehicular traffic from local streets to collectors or arterials. A minor collector may also provide limited access to abutting properties if approved by the City. Additionally, the streets identified as collectors on the Thoroughfare Plan may be designed as minor collectors only if approved by the City.
<b>Operator</b>	<p>The person or persons who, either individually or taken together, meet the following two criteria:</p> <ol style="list-style-type: none"><li>(1) they have operational control over the site specifications (including the ability to make modifications in specifications); and</li><li>2) they have the day-to-day operational control of those activities at the site necessary to ensure compliance with plan requirements and permit conditions.</li></ol>
<b>Other Municipal Ordinances</b>	Ordinances such as, but not limited to, zoning, subdivision, and building.
<b>Owner</b>	The person who owns a facility or part of a facility.
<b>Parkway</b>	The area between the back of curb and right-of-way line. This area is usually maintained by the property owner or a private association.
<b>Pavement Width</b>	Shall mean the portion of the surface of the street available for traffic: where curbs are used, it is measured between the back of curbs.
<b>Qualified Personnel</b>	Persons who possess the appropriate competence, skills, and ability (as demonstrated by sufficient education, training, experience, and/or, when applicable, any required certification or licensing) to perform a specific activity in a timely and complete manner consistent with the applicable regulatory requirements and generally-accepted industry standards for such activity.

# GLOSSARY

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<b>Recreational Vehicle</b>	Means a vehicle which is (i) built on a single chassis; (ii) 400 square feet or less when measured at the largest horizontal projections; (iii) designed to be self-propelled or permanently towable by a light duty truck; and (iv) designed primarily not for use as a permanent dwelling but as temporary living quarters for recreational, camping, travel, or seasonal use.
<b>Registered Landscape Architect (RLA)</b>	A person who has been duly licensed and registered to practice landscape architecture by the Texas Board of Architectural Examiners.
<b>Rural Collector Street</b>	A street in the ETJ of the City which primarily serves vehicular traffic from locals to arterials. A rural collector may provide limited access to abutting residential properties if approved at the time of platting by the City and County. Construction and maintenance of the rural collectors are generally under the jurisdiction of the County.
<b>Rural Local Street</b>	A street in the ETJ of the City which primarily serves vehicular traffic to abutting residential properties. A rural local may also provide limited access to commercial properties if approved at the time of platting by the City and County. Construction and maintenance of the rural locals are generally under the jurisdiction of the County.
<b>Sanitary Sewer (or Sewer)</b>	The system of pipes, conduits, and other conveyance which carry industrial and domestic sewage from their sources, whether treated or untreated, to the sewage treatment plant serving the City (and to which stormwater, surface water, and groundwater are not intentionally admitted).
<b>Service Lead</b>	A wastewater line extending from a collection line or main to a private property or easement line making connection to the private service, including the required cleanout(s).
<b>Site</b>	The land or water area where any facility or activity is physically located or conducted, including adjacent land used in connection with the facility or activity.
<b>TAS</b>	Texas Accessibility Standards

# GLOSSARY

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<b>Use</b>	Any purpose for which a building or other structure or a tract of land may be designed, arranged, intended, maintained, or occupied; or any activity, occupation, business, or operation carried on, or intended to be carried on, in a building or other structure or on a tract of land.
<b>Use Permit</b>	The permit required before any use may be commenced.
<b>Variance</b>	A grant of relief to a person from the requirements of this manual when specific enforcement would result in unnecessary hardship. A variance, therefore, permits construction or development in a manner otherwise prohibited by this manual.
<b>Violation</b>	The failure of a structure or other development to be fully compliant with this manual.

# **BRYAN / COLLEGE STATION UNIFORM DESIGN GUIDELINES**

## **Domestic Water**



# DOMESTIC WATER

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## **GENERAL:**

The purpose of this manual is to establish certain minimum criteria for the design of water distribution mains in the Cities' jurisdiction. It is intended to be used by the city staff and private consulting engineers for all new utility construction, replacements and modifications to the existing systems. Unusual circumstances or special designs requiring exception from the standards in this manual must be approved by the City Engineer.

This manual is intended to be used in conjunction with all current American Water Works Association (AWWA) and Texas Commission on Environmental Quality (TCEQ) requirements. Additionally, all design should be in accordance with the adopted version of the International Fire Code. In the case of a conflict between this manual and either or both of these other requirements, the most restrictive will govern.

The criteria outlined in this manual are also intended to be used in conjunction with the Cities' Unified Technical Specifications.

For the purpose of this manual, water distribution mains are those mains of 18 inches in diameter or smaller. Larger diameter mains are considered to be transmission mains and are subject to additional design criteria and review.

## **Submittal Requirements**

The design engineer shall submit the following information with all water system designs:

- Plan and profile sheets containing all information necessary to review, construct and inspect the improvements. This shall include a traffic control plan as applicable
- Water Design Report showing that the design of the proposed improvements meets the requirements of this manual (such as fire flows, pressure, maximum run lengths, velocities, etc.)
- Copy of information provided to TCEQ in compliance with TCEQ submittal requirements (TAC290) for City records purposes. If the project is exempted from TCEQ submittal, this submittal to the City is also exempted.

# DOMESTIC WATER

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**Special Designs** The City Engineer may, upon request, approve an alternative design or construction methodology that differs from the requirements in this manual if the City Engineer determines that: (1) the alternative design or construction methodology is equivalent to, or superior to, the methodology required in this manual, and (2) the alternative design or construction methodology is sufficient to ensure public health and safety.

**Connections** All connections and service leads shall be installed to both sides of all roads and alleys at the time of main line installation.

Service connections to 16" or larger water mains shall not be allowed.

**PIPE SELECTION:** Pipes shall be selected, sized and designed to provide a safe, efficient and maintainable system for the conveyance of domestic water from existing supplies and systems to new or existing users.

**Pipe Materials** The following pipe materials may be specified for water distribution mains:

Ductile iron pipe (DIP), pressure class 350 for sizes 6 through 12 inches and pressure class 250 for sizes greater than 12 inches. Where excessive depths are encountered (greater than 10 feet), the design engineer shall specify an appropriate thickness class to be approved by the City Engineer.

Polyvinyl chloride pipe (PVC) shall be SDR-21, ASTM D2241 pressure class 200 for 3 inch; pressure class 200 DR14 (meeting AWWA C-909 standards) for sizes 6 through 12 inches; and pressure class 235 DR 18 (meeting AWWA C-905 standards) for pipe sizes greater than 12 inches. PVC pipe will not be permitted for aerial crossings. DI fittings shall be used with PVC pipe. Fittings shall be wrapped with eight-mil polywrap and sealed on the edges with an approved tape.

Type 'K' copper tubing shall be used for all service lines 2 inches and smaller.

Changes in pipe material shall only occur at valves or fittings with the exception of short replacements of water lines needed to meet TCEQ separation requirements.

# DOMESTIC WATER

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For material information on pipe encasements refer to “Encasements” on Page 8.

Pipe Sizing	Pipes and pipe systems shall be designed to provide the service criteria listed below.
Standard Pipe Sizes	The standard pipe sizes for water distribution mains are 3, 6, 8, 10, 12, 16, 18, and 24 inches in diameter. As discussed in the “Maximum Lengths for Water Mains” Section, the smaller lines have restrictions for use. Standard size service lines within the right of way shall be 1, 1½, or 2 inch Type ‘K’ Copper.
Looping Requirements	<p>Permanent dead-end mains will not be allowed if looping alternatives are available. This may require extending the water lines beyond project limits.</p> <p>Dead-end mains will be allowed at ends of cul-de-sacs where the only alternative is to loop lines down side lot lines in residential subdivisions. It is preferred to use 3 inch diameter lines where the maximum length as described in the following section is not exceeded.</p>
Maximum Lengths for Water Mains	<p>A 3 inch line may be allowed for permanent dead-end mains not exceeding 500 feet. A 6 inch main may be allowed up to a maximum of 1500 feet in length and must connect at each end to an 8 inch or larger main and shall have no more than 2 fire hydrants or flushing points. Where it is not possible to meet this requirement, a 6-inch main may be extended to a maximum of 800 feet in length and shall terminate with a fire hydrant or blow-off assembly.</p> <p>TCEQ rules shall dictate the number of services allowed on the smaller sized line.</p>
Pressure/Flow Requirements	Water distribution mains shall be sized to meet all of the following requirements using a Hardy-Cross based analysis method or methods encompassed in software packages such as KY-Pipe, MikeNet, or Cybernet.
Design Flow Calculation	Both normal and fire flows are needed for meeting the design criteria as established under Design Flow Calculation and System Design Criteria.

# DOMESTIC WATER

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## Normal Flow

One of the following three methods shall be used to determine the normal flows by which the water system is to be designed.

Peak Hourly Flow = (Average Daily Flow)(4)

- Method 1 – Fixture Count Determination

For small demand uses, the “fixture unit” method of estimating *peak* water demand may be used in accordance with the current duly adopted City Plumbing Code.

For larger multi-family, residential, institutional, commercial and industrial uses (over 500 fixture units), Tables I and II should be used. Table I shows a fixture unit value for various plumbing fixtures and groups of fixtures. Table II shows the probable peak rate of demand from systems consisting of various numbers of fixtures.

- Method 2 - Land Use Determination

Table III contains the normal flow demands that are expected from a variety of uses.

The population factor for residential land uses is 2.67 persons per unit, which is then applied to the actual number of units per acre, if known, or the maximum units per acre from the current land use plan if the property development is not yet finalized.

The population factors for non-residential uses are 30 persons per acre for commercial, office and institutional uses and 15 persons per acre for Industrial uses.

- Method 3 - Gross Area Determination

In the absence of projected land uses, the demands contained in Table IV may be used.

## Fire Flows

For the purposes of this manual, the following shall be used for fire flow determinations unless greater flows are required for hydrants near structures as per the adopted International Fire Code.

# DOMESTIC WATER

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- *Residential* 1500 gallons per minute for public hydrants in single family or duplex residential areas (this flow may be split between two adjacent fire hydrants within 1000 feet of each other).
- *Commercial* 2500 gallons per minute for public hydrants in commercial or multi-family areas (this flow may be split between two adjacent fire hydrants within 600 feet of each other).
- *Other/Hi-Rise* For onsite fire hydrants needed to obtain coverage of commercial or other high density uses, the design engineer shall consult the City Fire Marshal to obtain the specific fire flow demands for each project via the International Fire Code.

## Fire Flow System Design Criteria

The following criteria shall be met on all new water improvements. The determinations should use peak hour, peak day as defined by the Cities' Water System Model.

- Under normal conditions, provide residual pressures in the area serviced by the system improvement to meet TCEQ requirements, and at all times a minimum static pressure of 35 pounds per square inch (psi).
- Under fire flow conditions, provide the required fire flow at the most hydraulically remote pairings of 2 adjacent fire hydrants in the system improvement in addition to the peak hourly flow. A residual pressure of no less than 20 psi is required.
- Provide maximum velocities of not more than 12 feet per second (fps) during fire flow in both existing and proposed mains. This maximum velocity may be increased on a case by case basis depending on the condition of the existing mains and if an engineering evaluation has been performed.
- Conform to any area wide master plans, including over sizing for future development.

## PIPE ALIGNMENT:

The design of water distribution mains should provide for economical access for maintenance and repair, reliability of location and minimum disruption to surrounding facilities during repair operations. In all cases water facilities shall comply with TCEQ separation requirements.

## Horizontal Layout

The centerline of water distribution mains constructed in street rights-of-way shall be located as shown on the Typical Utility Location Detail (Figures 9 and 10 in the Streets

# DOMESTIC WATER

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section) and shall remain parallel to the right-of-way line when possible. Where possible, avoid placing water line fittings and connections under paved and fenced areas.

## Vertical Layout

Water distribution mains should be laid to as straight a grade as possible between cross street connections. Vertical alignment should avoid high or low points between connections. (See Flushing Design below)

All water distribution mains 12 inches in diameter and smaller shall have a minimum cover to finished surface of 4 feet. Mains greater than 12 inches in diameter shall have a minimum cover of 5 feet to finished surface.

## Flushing Design

Water distribution mains should have a means of a minimum cleaning velocity of 5 fps. Additionally, fire hydrants shall be placed close to low point as practical.

Air relief valves and flushing appurtenances shall be placed at critical locations including an air release valve at all peaks for lines 12" and larger and on smaller lines where the peak has an "A" of 10 or more.

All dead end lines shall be designed to allow adequate flushing capability. A flushing assembly shall be provided for all lines 8 inches in diameter and smaller, while lines greater than 8" shall end at a fire hydrant.

<b><u>Main Size</u></b>	<b><u>Blow-off</u></b>
3"	1"
6"	2"
8"	2"
12"	4" or Fire Hydrant
18"	4" or Fire Hydrant
≥24"	6"

## Deflections, Bends and Curves

The maximum deflection of pipe is to be restricted as shown in Table V. Deflection for PVC pipe shall be made along the pipe barrel and not at the joint, while ductile iron pipe shall be deflected at the joints. Service connections should be limited in curved sections of pipe.

All bends and fittings producing a change in alignment greater than the deflection allowance of this manual shall be restrained to the pipe and blocked to undisturbed soil. In addition, the pipe itself shall be restrained for a minimum of 2 joints on either side of the alignment change.

# DOMESTIC WATER

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Curvature of pipe shall be accomplished through multiple, spaced deflections as described above. The minimum radius of curvature for water pipes is shown in Table V.

Separation from  
Wastewater Facilities

Separation of public water and wastewater mains will be consistent with the current Rules and Regulations for Public Water Systems of the TCEQ.

## **VALVES :**

All mainline valves 12" in diameter or less shall be gate valves whereas valves in lines greater than 12 inch shall be butterfly valves.

Location and  
Spacing

A valve should be located:

- One (1) less than every leg of a cross connection.
- At the end of temporary dead-end lines, within 70 feet from the end of the line for lines greater than 8" and within 200 feet for lines equal to and less than 8".
- At the end of a public line (unless there is a meter)
- On 2 legs of a tee connection.
- Every 800 feet.
- Where possible, place valves in green areas and avoid handicap ramps.

A valve will be required at the point of connection of a new main extending an existing main unless the existing main has an in-line valve within 200 feet of the connection.

Valves shall be placed at intervals not to exceed 800 feet regardless of the distance between intersections. Wherever possible, they shall be located within 5 feet of a fire hydrant. The City Engineer may require additional valves to prevent unnecessary disruptions of service. Fire hydrant lead valves are to be positively anchored to the main line.

Valves are to be located so that no more than 4 valves are required to isolate a section of main.

Tapping Sleeves

Tapping Sleeves and valves will be allowed unless size on size connections are needed, and then Tee connections will be required. A Tee connection may also be required where main line valves are needed.



# DOMESTIC WATER

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**FIRE HYDRANTS:** Fire hydrants are to be located at street intersections or as close to an intersection as possible. Hydrants should not be located within the intersection curb return radius. Intermediate fire hydrants should be located near property line extensions and no closer than 5 feet to any service line.

In accordance with TCEQ, fire hydrants shall not be placed closer than 9 feet horizontally and vertically from any wastewater main or appurtenance. All fire hydrants shall be connected to a minimum 6 inch water main.

If it is necessary to place a fire hydrant in a proposed sidewalk location, the sidewalk shall be widened or relocated to maintain the required sidewalk width.

It is desirable for fire hydrants to be placed within 150 feet of a fire department connection on the structure.

## Residential Fire Hydrants

In residential areas fire hydrants should be placed within the right-of-way in the vicinity of the common lot lines.

Public fire hydrants shall be spaced 1000 feet apart in single-family districts at locations so that structures (or undeveloped lots) shall not be more than 500 feet from a fire hydrant as measured along the right of way of a public street as the fire hose is laid off the fire truck.

In residential areas with lots sizes of 5 acres or greater, fire hydrants may be spaced at 1,500 feet along the water main so that structures shall not be more than 750 feet from a fire hydrant as measured along the right of way of a public street as the fire hose is laid off the fire truck.

## Non-Residential Fire Hydrants

Public fire hydrants in districts other than single family districts shall be installed as per the Cities Fire Codes.

Upon approval by the City Engineer, the installation of some or all public fire hydrants in such districts may be deferred and required as a condition of the building permit(s) for structures.

## CROSSINGS:

Water distribution mains that cross state highways must conform to the Cities' Unified Technical Specifications and the requirements of the Texas Department of Transportation (TxDOT). Mechanical bores are required for all crossings of existing streets.

# DOMESTIC WATER

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Water distribution mains that cross railroads must conform to the Cities' Unified Technical Specifications and the requirements of the railroad company whose right-of-way is being crossed.

For water distribution mains crossing creeks or drainage channels regulated by FEMA, shall require encasement. Below grade crossings are preferred; however aerial crossings may be considered. Thrust restraint shall be provided at points of transition from buried to exposed pipe and at changes in alignment of exposed pipe. Air release valves shall be provided at the high point of all crossings.

Below grade crossings of creeks and drainage channels shall have a minimum cover of 4 feet below the flowline at the time of construction. All below grade crossings requiring encasement shall be encased in steel encasement pipe and all ends shall be capped and sealed. The casing shall be carried into the bank a distance that should consider changes in the creek channel. This distance would usually be beyond the high bank such that if you measured a 1:1 slope from the high bank away from the channel, the casing would terminate at that location.

## **ENCASEMENT:**

Steel cylinder pipe shall be used for all encasement pipe. Other encasement pipe material may be used per TCEQ requirements and City specifications. Carrier pipes sized 30 inches or less shall use an encasement pipe with a wall thickness of no less than 3/8-inch. For larger carrier pipes, a wall thickness of no less than 1/2-inch shall be used. Coating of encasement pipe may be required in special soil conditions.

Pipe encasement will be required for all water mains crossing any street classified as major collector and greater including new streets regardless of method of installation. This does not apply to services. Special field conditions may require an alternate method of installation, which must be approved by the City Engineer.

The encasement pipe shall be sized in accordance with the Unified Technical Specifications and shall extend 2 feet beyond the back of both curbs on the street. Ends of encasement pipes shall be sealed to prevent the intrusion and collection of groundwater.

# DOMESTIC WATER

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All carrier pipes will be supported by casing spacers in accordance with the specifications and details, and shall have joints restrained by an approved method that will allow the removal of the carrier pipe from the encasement pipe in a single direction by means of tension on the carrier pipe only.

## **EASEMENTS:**

Water mains that are not proposed to be constructed adjacent and parallel to public rights-of-way shall be in easements of not less than 15 feet in width. Water mains that are buried deeper than 8 feet shall be in easements not less than 20 feet. When unavoidable for both water and wastewater mains to be located within the same easement, the width shall not be less than 30 feet unless either main is buried deeper than 8 feet, in which case, easement width shall be increased. Where water lines will be adjacent to building structures, easement width shall be increased.

The easement must be located such that the centerline of the waterline is no closer than 5.5 feet to the closest edge of the easement.

Water mains constructed adjacent to TxDOT maintained roadways shall be located in the utility accommodation zone provided by TxDOT. If there is no utility accommodation zone, or if the zone is occupied, then the water line shall be installed in a separate easement (min. 15 feet) adjacent to the right-of-way.

# DOMESTIC WATER

**TABLE I**  
**FIXTURE UNITS PER UNIT OR GROUP**

<b>FIXTURE TYPE</b>	<b>FIXTURE UNIT VALUE LOAD FACTOR</b>
One Bathroom Group - tank operated water closet, tub or shower, lavatory	6
Bathtub (with or without shower)	2
Dishwasher (domestic)	2
Kitchen Sink	1
-with food grinder	2
Lavatory	2
Shower Group, per head	3
Sinks, commercial	
-Surgeon's	3
-Flushing Rime (with valve)	8
-Service	3
-Pot (scullery, etc.)	4
Urinals	4
Washer, clothes	4
Water Closets	
-Tank Operated	4
-Valve Operated	8

# DOMESTIC WATER

**TABLE II  
PEAK WATER DEMAND BASED ON FIXTURE UNITS**

<b>FIXTURE UNITS</b>	<b>PEAK DEMAND (GPM)</b>
500	125
1000	215
1500	300
2000	330
2500	380
3000	420
3500	490
4000	560
4500	630
5000	700
6000	840
7000	980
8000	1120
9000	1260
10000	1330

**TABLE III  
AVERAGE WATER DEMANDS**

<b>USE</b>	<b>AVERAGE FLOW GPD / CAP</b>
Residential	100
Commercial	
-Office	50
-Retail	25
-Hotel/Motel	150
Institutional	
-Schools	35
-Hospitals	200
Industrial	50

# DOMESTIC WATER

**TABLE IV  
NORMAL WATER DESIGN DEMANDS**

<b>TRIBUTARY AREA (Acres)</b>	<b>DESIGN DEMAND (g.p.d. per acre)</b>
Less than 250	7000
250-300	6500
300-500	5500
500-1500	5000
1500-3000	4500
More than 3000	4000

**TABLE V  
MINIMUM RADIUS FOR WATER PIPE**

<b>SIZE</b>	<b>PVC – CLASS 200 (20-ft. Joint)</b>	<b>DUCTILE IRON (18-ft. Joint)</b>
6-IN	220 ft	400 ft
8-IN	400 ft	400 ft
12-IN	600 ft	400 ft

# **BRYAN / COLLEGE STATION UNIFORM DESIGN GUIDELINES**

**Sanitary Sewer**

# SANITARY SEWER

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# SANITARY SEWER

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## GENERAL:

The purpose of this manual is to establish certain minimum criteria for the design of wastewater collection mains in the Cities' jurisdiction. It is intended to be used by the city staff and private consulting engineers for all new utility construction, replacements and modifications to the existing systems. Unusual circumstances or special designs requiring exception from the standards in this manual must be approved by the City Engineer.

This manual is intended to be used in conjunction with all current American Water Works Association (AWWA) and Texas Commission on Environmental Quality (TCEQ) requirements. In the case of a conflict between this manual and either or both of these other requirements, the most restrictive will govern.

The criteria outlined in this manual are also intended to be used in conjunction with the Cities' Unified Technical Specifications.

For the purpose of this manual, wastewater collection mains are those mains of 18 inches in diameter or smaller. Larger diameter mains are considered to be interceptor or transmission mains and are subject to additional design criteria and review.

Proposed wastewater collection systems that accept flows from existing upstream sewers shall be designed to accommodate all flows generated by the upstream service area. The existing upstream sewers may experience variable peak flows greater than the peaks utilized in the design of new sewers. The peak flow rates (particularly the infiltration/inflow rates) for each existing subsystem is highly variable. Consult with the City Engineering Services Department to confirm the proper peak flow rates to be used for any existing upstream wastewater collection system. The proposed wastewater collection system design shall include a review of all existing downstream sewers receiving flow from the proposed sewers to verify that flows generated from the proposed wastewater collection system do not adversely affect the performance of the downstream systems.

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## Submittal Requirements

The design engineer shall submit the following information with all wastewater system designs:

- Plan and profile sheets containing all information necessary to review, construct and inspect the improvements. This shall include a traffic control plan as applicable
- Wastewater Design Report showing that the design of the proposed improvements meet the flow requirements of this manual.
- Copy of information provided to TCEQ in compliance with TCEQ submittal requirements (TAC317) for City records purposes. If the project is exempted from TCEQ submittal, this submittal to the City is also exempted.

## Special Designs

The City Engineer may, upon request, approve an alternate design or construction methodology that differs from the requirements in this manual if the City Engineer determines that : (1) the alternative design or construction methodology is equivalent to, or superior to, the methodology required in this manual, and (2) the alternative design or construction methodology is sufficient to ensure public health and safety..

Lift station design shall follow acceptable engineering practices and be reviewed by City staff.

## Connections

All residential connections and service leads shall be installed to both sides of all roads and alleys at the time of main line installation.

Service connections shall be tied into the main line.

## PIPE SELECTION:

Pipes shall be designed to provide a safe, efficient and maintainable system for the collection of wastewater from its various sources of generation to the existing collection and interceptor systems.

## Pipe Materials

The following pipe materials may be specified for wastewater, collection, and force mains as well as service lines within the City's rights-of-ways.

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Ductile iron pipe (DIP), pressure class 350 for sizes 6 through 12 inches and pressure class 250 for sizes greater than 12 inches. Force mains shall be DIP, pressure class 350 or ASTM D2241 pressure class 160 and shall not be greater in size than 8 inches.

Polyvinyl chloride pipe (PVC) and all fittings shall be SDR26-ASTM D3034 in sizes 6 through 12 inches and SDR26-ASTM D2241 for larger sizes. PVC pipe will not be permitted for aerial crossings.

For material information on pipe encasements refer to the "Encasements" section of this document.

Changes in pipe material shall only occur at manholes with the exception of short replacements of sewer lines needed to meet TCEQ separation requirements.

## Pipe Sizing

Pipes and pipe systems shall be designed to provide the service criteria listed below.

## Standard Pipe Sizes

The standard pipe sizes for wastewater collection mains are 6, 8, 10, 12, and 18 inches in diameter. Standard service leads shall not be more than 150 feet in length and shall terminate in a cleanout at the property line.

## Minimum Pipe Sizes

Minimum wastewater pipe sizes shall be as follows:

- Collection Mains – 6 inches
- Residential Service Leads – 4 inches (single & double)
- Commercial Service Leads – 6 inches (single only)

## Flow Requirements

Wastewater collection mains shall be sized to meet all of the following requirements using an analysis method based on Manning's equation.

## Flow Calculation

One of the following three methods shall be used to determine the peak hourly flows by which a new wastewater system at the fringes of the existing system is to be designed (For new systems being developed within the existing system, consult the Wastewater Master Plan for design criteria). In each method, the following equations apply:

Peak Hourly Flow = (Average Daily Flow)(4)

- Method 1 - Fixture Count Determination

For multi-family residential, institutional, commercial and industrial uses, the “fixture unit” method of estimating peak wastewater generation may be used in accordance with the current duly adopted City Plumbing Code. Table I shows a fixture unit value for various plumbing fixtures and groups of fixtures. Table II shows the probable peak rate of flow generation from systems consisting of various numbers of fixture units.

- Method 2 – Land Use Determination

Table III contains the average daily flow per capita to be expected from a variety of uses.

The population factor for residential land uses is 2.67 persons per unit, which is then applied to the actual number of units per acre if known, or the maximum units per acre from the current land use plan if the property development is not yet finalized.

The population factors for non-residential uses are 30 persons per acre for commercial, office and institutional uses and 15 persons per acre for Industrial uses.

- Method 3 - Gross Area Determination

If beyond the boundaries of the current Wastewater Master Plan and/or in the absence of projected land uses, the average daily flow per acre contained in Table IV may be used.

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- Method 4 – Historical Data

If there is information regarding average daily flows for a particular type of development that is more accurate than the data from the other methods, the historic information may be used. Please discuss this with the City prior to using so as to ensure the information is acceptable.

**System Design Criteria** Wastewater mains and collection lines shall be designed to carry the peak daily load estimated from the tributary areas when fully developed to the current land use plan. Determination of peak loadings shall be based on an analysis of the density and character of the land uses in the tributary area and the probable wastewater generation from those uses.

## MINIMUM / MAXIMUM PIPE SLOPES

PIPE SIZE	SLOPE (%)	
	MINIMUM	MAXIMUM
6"	0.80	7.80
8"	0.40	5.30
10"	0.30	3.90
12"	0.25	3.10
18"	0.20	1.80
24"	0.20	1.20
30"	0.20	0.90
36"	0.20	0.70

For lines larger than 36 inches in diameter, the slope may be determined by Manning's formula to maintain a minimum velocity greater than 2.5 feet per second when flowing full and a maximum velocity less than 8 feet per second when flowing full when using a Manning's "n" of 0.013.

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Pipe velocities should be consistent between manholes and avoid abrupt reductions in velocity.

## **PIPE ALIGNMENT:**

The design of the wastewater collection mains should provide economical access for maintenance and repair, reliability of location and minimum disruption to surrounding facilities during repair operations. In all cases wastewater facilities shall comply with TCEQ requirements.

### Horizontal Layout

Wastewater mains and collection lines should be laid straight between manholes and at a uniform distance from the right-of-way line.

The centerline of wastewater mains and collection lines constructed in street rights-of-way shall be located as shown on the Typical Utility Location Detail (Figures 9 and 10 in the streets section), on the opposite side of the street from the water main.

### Vertical Layout

The desired minimum cover for sanitary sewer pipe shall be six feet (6') as measured from the outside top of pipe vertically to finished ground or pavement surface elevation. When it is necessary to reduce the cover, the design shall include ductile iron pipe and may include cement stabilized sand backfill for covers less than 3.5'. Any shallow depth sewer lines shall be discussed with the City Engineer.

Wastewater mains and laterals should be laid on a straight grade between manholes while avoiding excessive depths. Elevations must be shown on construction plans at 100-foot stations and at all manholes and match marks. Elevations are to be calculated to the nearest 0.01 foot.

Wastewater mains and collection lines must be constructed to a depth which will insure gravity flow in service connections to adjacent properties. In general, this is accomplished by setting a 2% grade from the centerline of the collection main to a point one (1) foot below floor elevation at the building line of the structure being served. The service lead must have a minimum cover of 2 feet at its shallowest point including roadside drainage ditches where present.

### Separation From Water Facilities

Separation of public water and wastewater mains will be consistent with the current Rules and Regulations for Public Water Systems of the TCEQ.

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## MANHOLES:

Manholes will be required at changes in horizontal alignment, changes in grade, changes in pipe size and junctions with other wastewater mains or collection lines. Manholes will not be required at the junctions where service leads join mains.

When connecting new sewer lines into existing manholes, the City will provide a point of connection.

The maximum distance between manholes shall be as per the requirements of TCEQ.

When a change in the size of a wastewater main or collection line occurs without a change in grade, the inside top of pipe (soffit) elevations will be matched in the manhole. Elevation differences between pipes at a manhole may require a drop manhole (see TCEQ for more information).

At the end of a main or collection line, the line shall be terminated with a manhole or clean out as per TCEQ requirements. If an extension is anticipated, a plugged stub-out of one full pipe joint with a clean-out is required.

Manholes may be constructed of fiberglass or concrete. Concrete manhole may be cast in place or precast. Fiberglass manholes may only be used in non-structural areas as a special design.

Manhole sizes shall be as follows:

<u>Manhole Diameter</u>	<u>Main Size</u>
4 ft	<18 in.
5 ft	≥18 in. < 30 in.
6 ft	≥36 in.

## RIGHT-OF-WAY CROSSINGS:

Wastewater collection mains that cross state highways must conform to the Cities' Unified Technical Specifications and the requirements of the Texas Department of Transportation (TxDOT).

Wastewater collection mains that cross railroads must conform to the Cities' Unified Technical Specifications and the requirements of the railroad company whose right-of-way is being crossed.

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For wastewater collection mains crossing creeks or drainage channels, piers must support the elevated sections of such crossings.

Below grade crossings of creeks and drainage channels shall have a minimum cover of 3.5 feet below the flowline at the time of construction or shall be constructed of ductile iron pipe. Another option is to adequately protect the pipe from stream erosion by concrete encasement or other approved means. See more specific information in Specification 400.

Dry bore all crossings of existing streets unless otherwise authorized by the City Engineer.

## **ENCASEMENTS:**

Steel cylinder pipe shall be used for all encasement pipe. Other encasement pipe material may be used per TCEQ requirements and City Specifications. Carrier pipes sized 30 inches or less shall use an encasement pipe with a wall thickness no less than 3/8-inch. For larger carrier pipes, a wall thickness of no less than 1/2-inch shall be used. Coating of encasement pipe may be required in special soil conditions.

Pipe encasement will be required for all wastewater collection mains crossing any existing street and on new streets classified as major collector or greater. This does not apply to services. Special field conditions may require an alternate method of installation, which must be approved by the City Engineer.

Encasement pipe diameter shall be as specified in the Technical Specifications. Encasement pipes shall extend 2 feet beyond the back of both curbs on the street. Ends of encasement pipes shall be sealed to prevent the intrusion and collection of groundwater.

All carrier pipes will be supported by Cascade carriers (or approved equal), that will allow the removal of the carrier pipe from the encasement pipe in a single direction by means of tension on the carrier pipe only.



## **EASEMENTS:**

Wastewater lines constructed outside of public rights-of-way shall be in easements of not less than 15 feet in width unless sewer main bury is deeper than 4 feet, in which case, easement width shall be increased to 20 feet. If both water and wastewater mains are located within the same easement, the width shall be not less than 20 feet unless either main is buried deeper than 14 feet, in which case, easement width shall be increased to 30 feet.

The easement must be located such that the centerline of the wastewater line is no closer than 5.5 feet to the closest edge of the easement.

Wastewater collection mains constructed adjacent to TxDOT maintained roadways shall be located in a utility easement. The main may be allowed within a utility accommodation zone provided by TxDOT on a case by case basis.

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**TABLE I**  
**FIXTURE UNITS PER UNIT OR GROUP**

FIXTURE TYPE	FIXTURE UNIT VALUE LOAD FACTOR
One Bathroom Group – tank operated water closet, tub or shower, lavatory	6
Bathtub (with or without shower)	2
Dishwater (domestic)	2
Kitchen Sink	1
With food grinder	2
Lavatory	2
Shower Group, per head	3
Sinks, commercial	
-Surgeon's	3
-Flushing Rim (with valve)	8
-Service	3
-Pot (scullery, etc.)	4
Urinals	4
Washer, clothes	4
Water Closets	
-Tank Operated	4
-Valve Operated	8

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**TABLE II**  
**PEAK WASTEWATER FLOWS BASED ON FIXTURE UNITS**

FIXTURE UNITS	PEAK DEMAND (GPM)
500	125
1000	215
1500	300
2000	330
2500	380
3000	420
3500	490
4000	560
4500	630
5000	700
6000	840
7000	980
8000	1120
9000	1260
10000	1330

**TABLE III**  
**AVERAGE WASTEWATER GENERATIONS**

USE	AVERAGE FLOW GPD/CAP
Residential	100
Commercial	
-Office	50
-Retail	25
-Hotel/Motel	150
Institutional	
-Schools	35
-Hospitals	200
Industrial	50

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**TABLE IV  
AVERAGE DAILY DESIGN FLOWS**

<b>TRIBUTARY AREA (Acres)</b>	<b>DESIGN DEMAND (g.p.d. per acre)</b>
Less than 250	7000
250-300	6500
300-500	6000
500-1000	5500
1000-2000	5000
2000-3000	4500
More than 3000	4000